

The use of prognostic models on individual patients: opportunities and limits

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The GiViTI prognostic models

Outcome: hospital mortality.

Two models:

- ▶ $\text{LOS} \geq 24h$
- ▶ $\text{LOS} < 24h$

The prediction from the models

Score =

Independent variables	Coefficients (95% CI)	Odds Ratio (95% CI)
Intercept	-7.02 (-7.51;-6.52)	/
Miscellanea		
Age in decades	0.37 (0.31;0.43)	1.45 (1.37;1.53)
Body mass Index (BMI) (Underweight vs. Normal)	0.33 (0.02;0.64)	1.39 (1.02;1.9)
Body mass Index (BMI) (Overweight or Obese vs. Normal)	-0.41 (-0.57;-0.24)	0.67 (0.56;0.79)
Surgical status (Non surgical vs. Elective surgical)	0.42 (0.16;0.69)	1.53 (1.17;1.99)
Surgical status (Emergency surgical vs. Elective surgical)	0.44 (0.21;0.67)	1.55 (1.23;1.96)

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Independent variables	Coefficients (95% CI)	Odds Ratio (95% CI)
Physiopatological components		
Bilirubin (mg/100ml) (4-11.9 vs. <4)	0.45 (0.27;0.64)	1.57 (1.31;1.89)
Bilirubin (mg/100ml) (>=12 vs. <4)	1.13 (0.71;1.54)	3.09 (2.04;4.67)
Sodium (mEq/L) (>=145 vs. <145)	0.19 (0.11;0.28)	1.21 (1.11;1.32)
Platelets (10 ³ /mm3) (50-99 vs. >100)	0.32 (0.22;0.43)	1.38 (1.25;1.53)
Platelets (10 ³ /mm3) (<50 vs. >100)	0.72 (0.57;0.86)	2.05 (1.77;2.37)
MAP (mmHg) (<70 vs. >70)	0.4 (0.31;0.48)	/

The prediction from the models

$$\text{Score} = -7.02 + 0.37 \times 6.0 + 0.33 + 0.44 + \dots$$

Independent variables	Coefficients (95% CI)	Odds Ratio (95% CI)
Clinical conditions on admission		
Acute intoxication (Yes vs. No)	-0.98 (-1.32;-0.64)	0.38 (0.27;0.53)
Spontaneous Intraparenchymal bleeding (Yes vs. No)	0.51 (0.33;0.7)	/
ALI (Acute Lung Injury) (Yes vs. No)	0.15 (0;0.3)	1.16 (1;1.36)
ARDS (Yes vs. No)	0.45 (0.25;0.64)	1.56 (1.28;1.9)
Haematological disease (Yes vs. No)	0.58 (0.25;0.9)	1.78 (1.28;2.47)
Ascites (Yes vs. No)	0.49 (0.16;0.82)	1.63 (1.17;2.27)

The prediction from the models

Score = -1.1

The prediction from the models

$$\text{Score} = -1.1$$

$$\text{prob} = \frac{e^{\text{Score}}}{1 + e^{\text{Score}}}$$

The prediction from the models

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$$\text{prob} = \frac{e^{\text{Score}}}{1 + e^{\text{Score}}}$$

$$\text{prob} \simeq 0.25$$

Model evaluation on ICUs

0.25

Model evaluation on ICUs

$$0.25 + 0.61 + 0.12 + 0.95 + \dots$$

Model evaluation on ICUs

$$0.25 + 0.61 + 0.12 + 0.95 + \dots = E$$

$$E \longleftrightarrow O$$

SMR

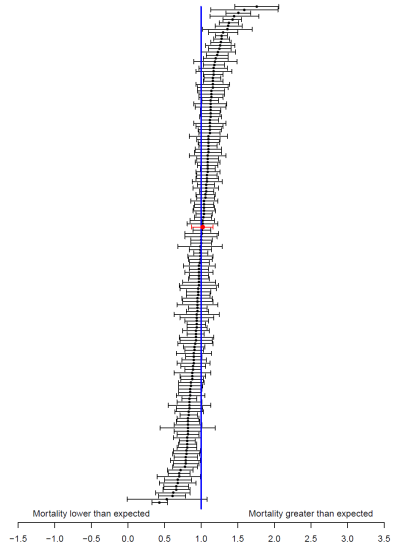
Total patients = 283

Total expected deaths (E) = 75.8

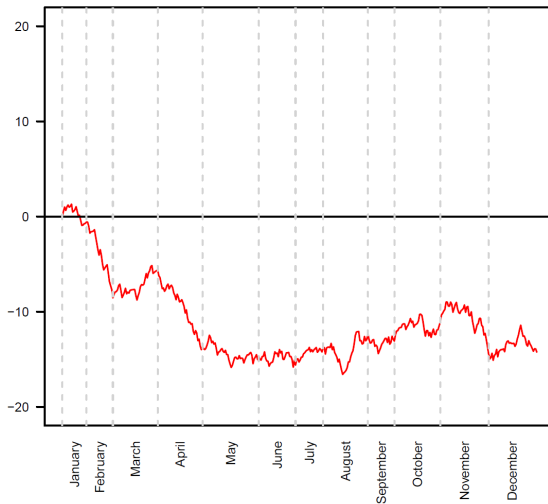
Total observed deaths (O) = 77

Ratio O/E = 1.02

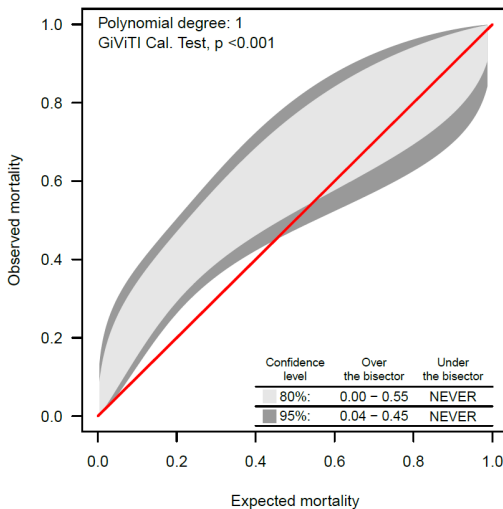
Confidence interval O/E (95%) = (0.87,1.16)



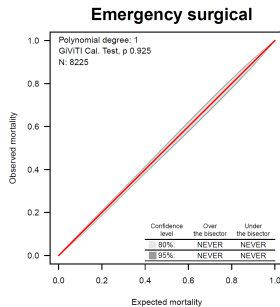
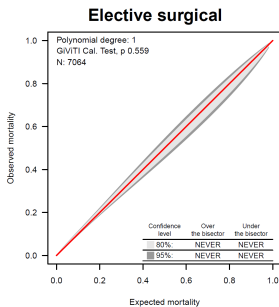
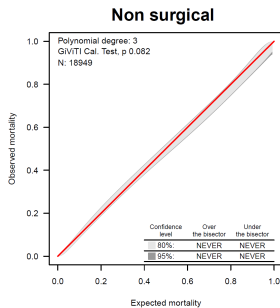
VLAD



Calibration belt



Subgroup analysis



Subgroup analysis

Calibration belt on

- ▶ $LOS \geq 24h$
 1. Non surgical patients
 2. Elective surgical patients
 3. Emergency surgical patients
- ▶ $LOS < 24h$
 1. Elective surgical patients

Subgroup analysis

Calibration belt on

- ▶ $LOS \geq 24h$
 1. Non surgical patients
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- ▶ $LOS < 24h$
 1. Elective surgical patients

or...

... whatever you want!

Analizzatore
Vulturno

nattino giovanni (giovanni)
impostazioni - esci

GiViTi web
Elenco Analisi
Analisi in corso
Metabase
Variabili
Codifiche

Guida all'utilizzo [Richiedi Analisi](#)

Elenco Analisi

All

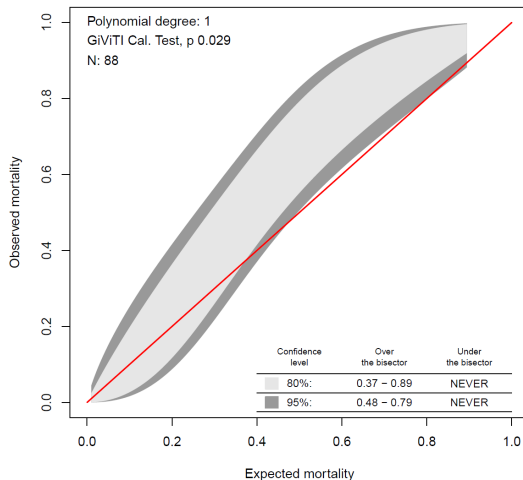
Nome Note Data
 Tipo Stato

[Filtro](#) [Reset](#)

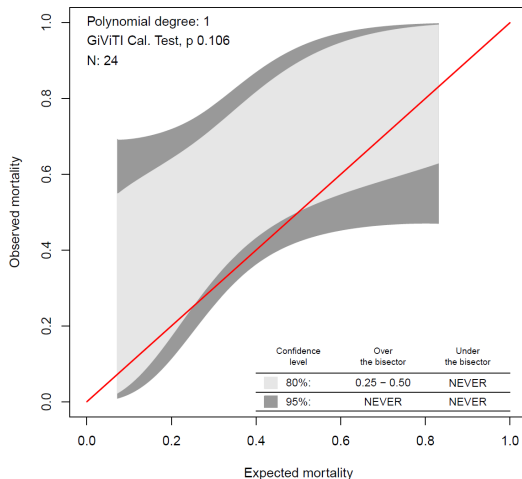
744 Analisi trovate [>](#) [<](#) pagina 1 di 50

Nome	Note	Tipo	Data	Stato
IT000 - Validità dati - Anno corrente	Modello: Non applicabile. Centri: La mia TI.	Validità dati - Anno corrente	29/10/2013 19.48.49	Scaricata
IT999 - Rapporto descrittivo	Modello: Non applicabile. Centri: La mia TI. Periodo: 01/01/2013 - 29/10/2013. Pazienti: Pazienti adulti degenti >=24 ore, ARDS-SI.	Rapporto descrittivo	29/10/2013 15.55.28	Scaricata
IT000 - Banda di calibrazione	Modello: GiViTi 2012. Centri: La mia TI. Periodo: 01/01/2013 - 29/10/2013. Pazienti: Pazienti adulti. Nessuna variabile selezionata.	Banda di calibrazione	29/10/2013 12.59.05	Scaricata
IT999 - Rapporto descrittivo	Modello: Non applicabile. Centri: La mia TI. Periodo: 01/01/2013 - 29/10/2013. Pazienti: Pazienti adulti. Nessuna variabile selezionata.	Rapporto descrittivo	29/10/2013 8.41.36	Scaricata

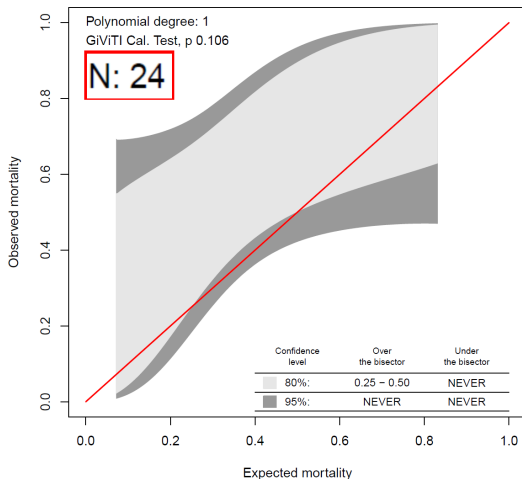
From population...



From population...



From population...



...to individuals

Who are those patients?

...to individuals

Who are those patients?

- ▶ Deceased \Rightarrow if higher mortality

...to individuals

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Unexpected deaths

First idea: Deceased with low probability of death ($< 0.10?$)

Unexpected deaths

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NO!

Unexpected deaths

First idea: Deceased with low probability of death ($< 0.10?$)
= “unlikely” deaths

NO!

Patients	Probability
Pt. 1	0.05
Pt. 2	0.05
Pt. 3	0.05
⋮	⋮
Pt. 100	0.05

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Pt. 1	0.05
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Expected deaths (E) =

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Pt. 1	0.05
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$$\text{Expected deaths (E)} = 0.05 \times 100$$

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Expected deaths (E) = $0.05 \times 100 = 5$

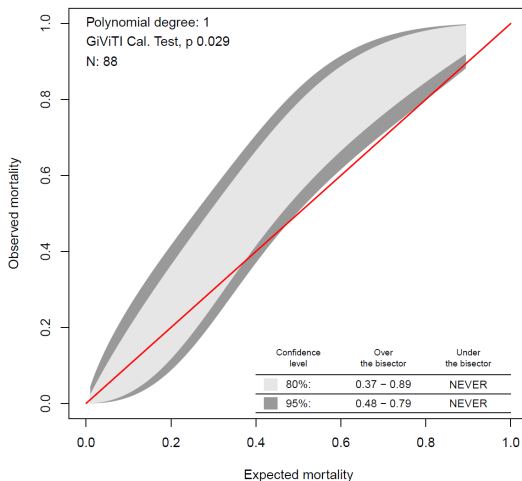
Deceased with probability of death < 0.10 (O) = 5

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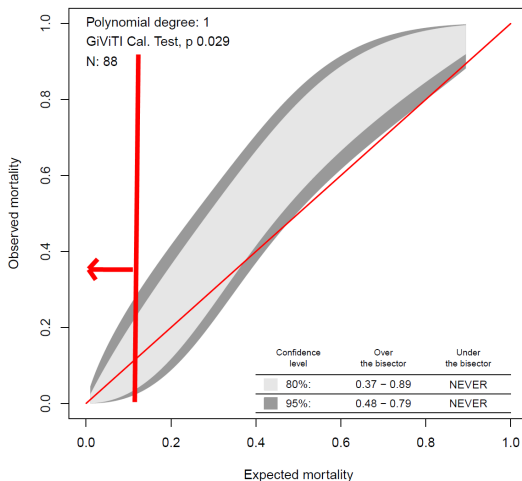
Expected deaths (E) = $0.05 \times 100 = 5$

Deceased with probability of death < 0.10 (O) = 4

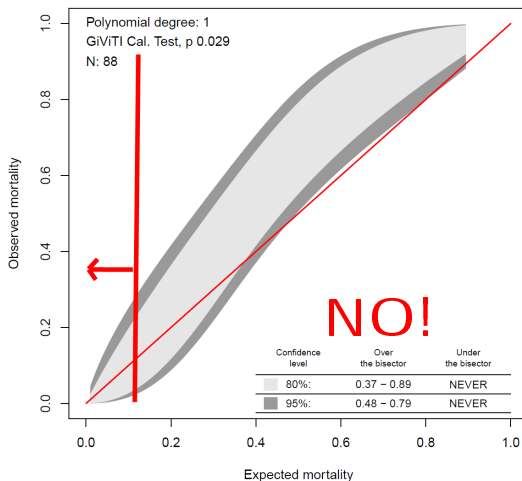
Unexpected deaths



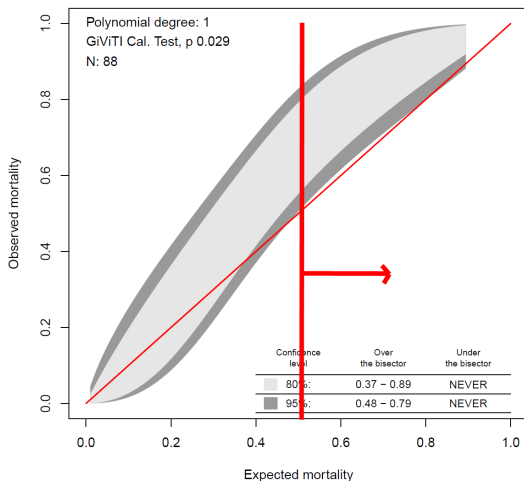
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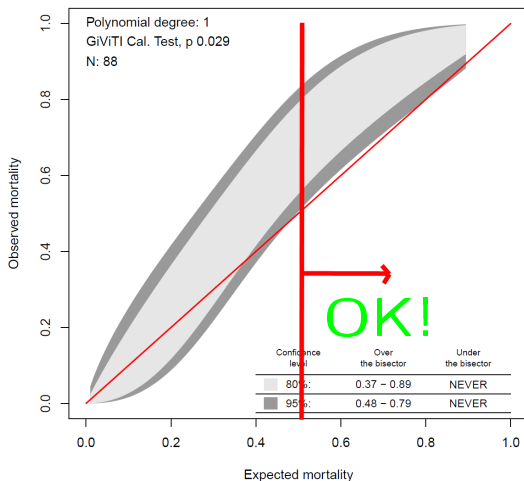
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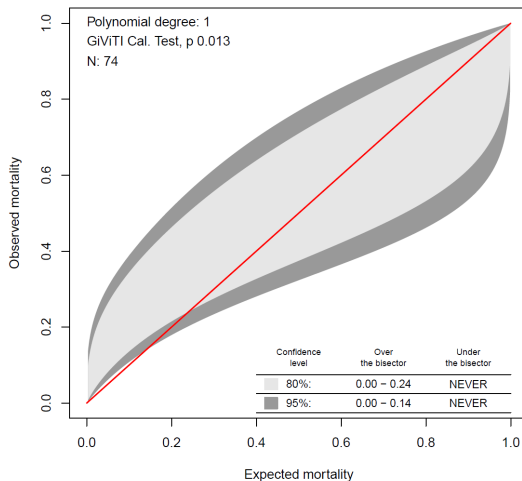
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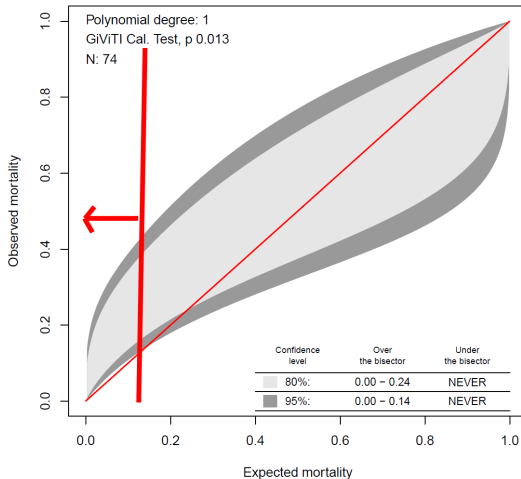
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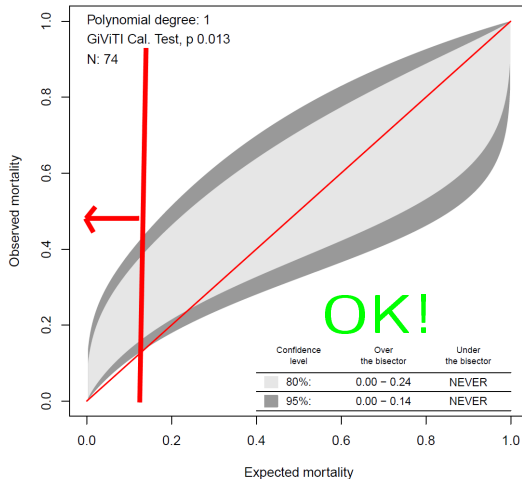
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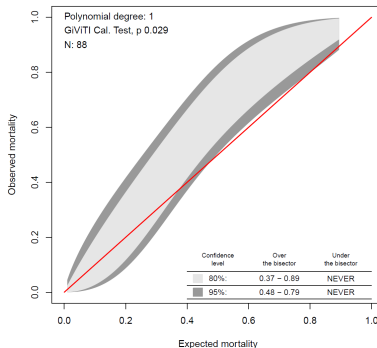
Unexpected deaths



Unexpected deaths

Total patients = 88
Total expected deaths (E) = 36.5
Total observed deaths (O) = 45

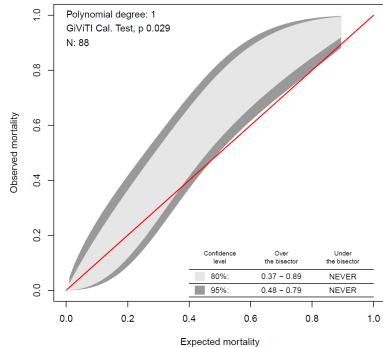
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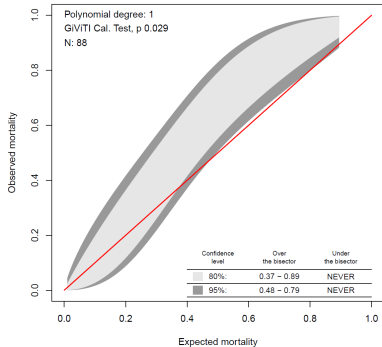


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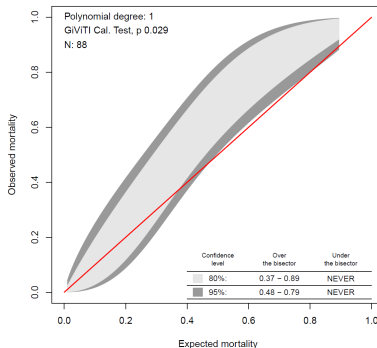


45 - 36.5

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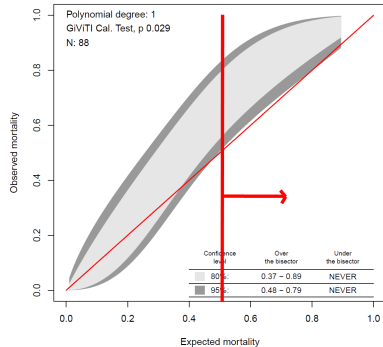


$$45 - 36.5 = 8.5$$

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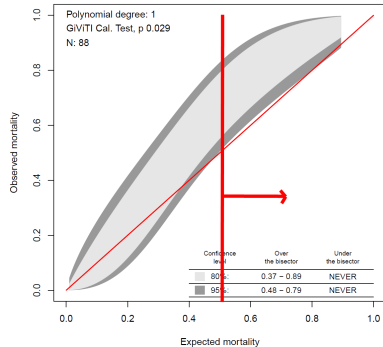


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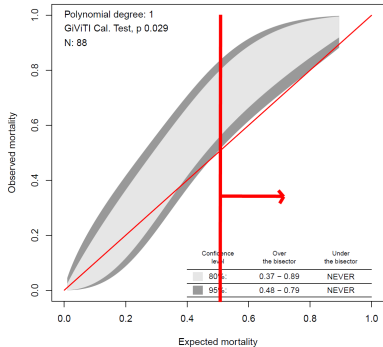


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⇓
31 deaths

Internal audit

Admission Key	Prob. GiViTI
A-IT999-326	0.48
A-IT999-346	0.56
A-IT999-372	0.99
A-IT999-378	0.76
A-IT999-384	0.58
A-IT999-392	0.83
A-IT999-400	0.96
A-IT999-408	0.85
A-IT999-409	0.99
A-IT999-432	0.82
A-IT999-467	0.52

Probability p on individual:

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- ▶ Error of the model

Probability p on individual:

- ▶ Error of the model \Rightarrow tell us!

Probability p on individual:

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- ▶ Avoidable problem

Probability p on individual:

- ▶ Error of the model \Rightarrow tell us!
- ▶ Unavoidable problem
- ▶ Avoidable problem \Rightarrow Most interesting

How-to

How-to

1. Medical record

How-to

1. Medical record
2. Possibly, check Prosafe

How-to

1. Medical record
2. Possibly, check Prosafe
3. Discuss!

How-to

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Conclusions

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- First experience: OK!

Conclusions

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- ▶ Need of structured analysis

Conclusions

- ▶ First experience: OK!
- ▶ Need of structured analysis \Rightarrow soon on Analyzer